C H A P T E R 7

Example Application

This chapter provides an example application of how to integrate ARC/INFO data sets with HEC-RAS using HEC-GeoRAS. The user is taken through a step by step procedure of how to develop an HEC-RAS Import File and view water surface profile data exported from HEC-RAS.

To perform the steps taken in the example application, the user must have an existing DTM of the river system to be modeled. Chapters 4-6 provide a more detailed discussion of the steps performed in the example.

Contents

Starting a New Project

Start up ARC/INFO and change directories to the workspace containing your DTM. To change workspaces use the WORKSPACE function just as you would using *cd* at the UNIX or DOS prompt. Type **georas**. The project manager window, shown in Figure 7.1 will appear.

Begin a new project by selecting **New Project** from the **File** menu on the

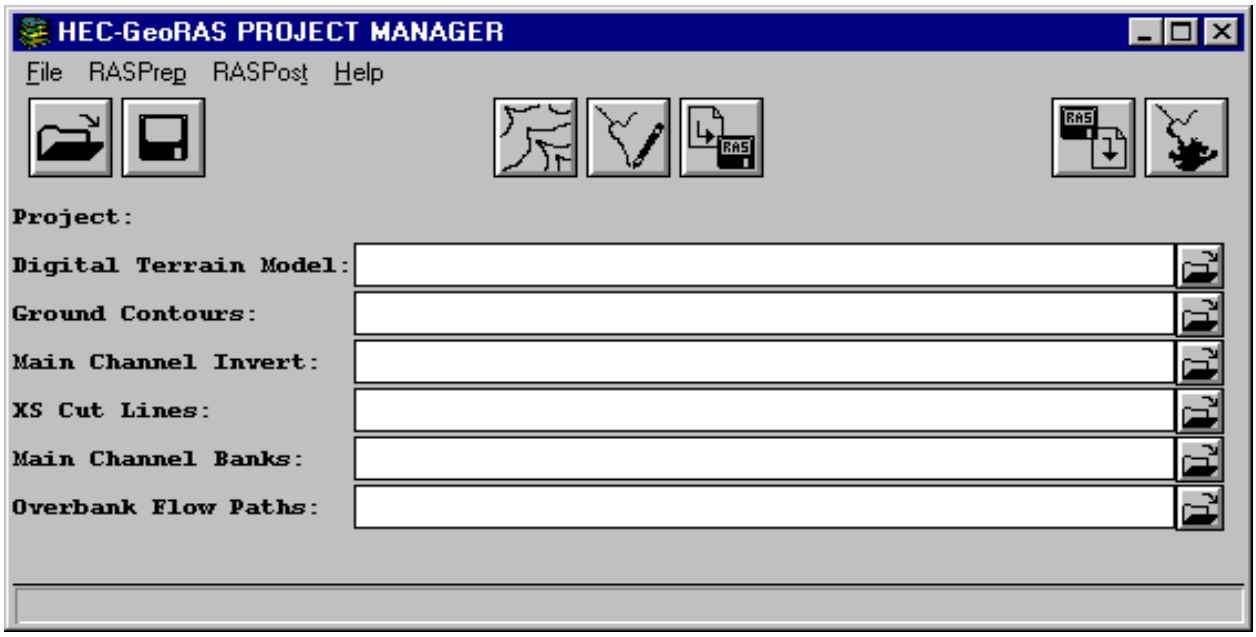

Figure 7.1 HEC-GeoRAS Project Manager window

project manager. Enter the name of the new project in the response window and press **OK**. The name of the project will be displayed in the *Project* field on the project manager.

Select the DTM using the browser or tight click over the *Digital Terrain Model* field. From the popup list, select the desired DTM with a left click.

Creating a Contour Coverage

A contour coverage must be created next. It will be used to help you create the RAS Coverages later. Press the **Create Contour Coverage** button on the project manager window. The window shown in Figure 7.2 is invoked (except the *Contour Coverage* field will be blank).

Enter the *Contour Coverage* name and a *Contour Interval* and press **Create Contour Coverage**. Processing of the Contour Coverage will take a few minutes, depending on the contouring interval and number of

points defining the DTM. After the coverage is created, you will be returned to the project manager. The name of the Contour Coverage created will be listed in the corresponding input field.

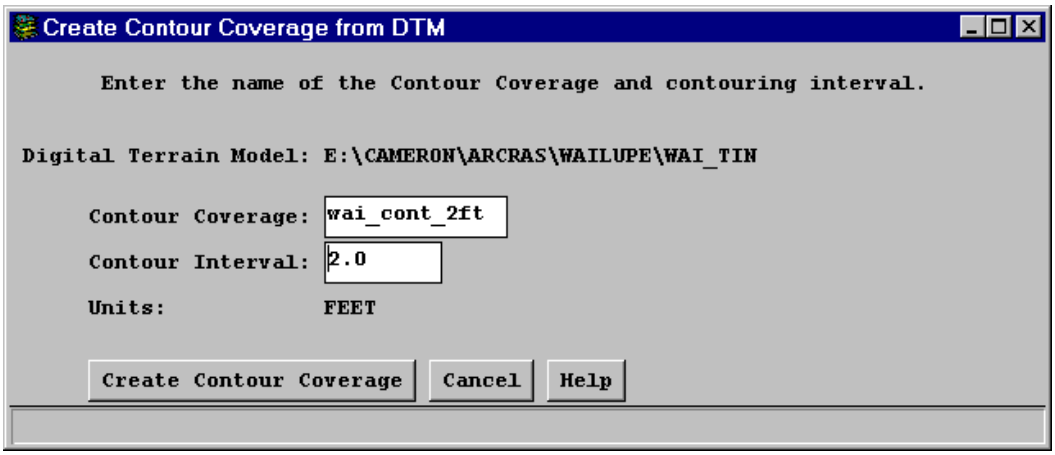

Figure 7.2 Create Contour Coverage window

Create RAS Coverages

Access the coverage editing environment by pressing the **Create/Edit RAS Coverages** button on the project manager window. It will take a few seconds for the editing environment to come up as ARCEDIT loads. The Edit RAS Coverages window, shown in Figure 7.3, will at last appear with an editing window. Resize the window as desired.

At this time, the editing window is blank. Select the *Ground Contours* checkbox on the Edit Ras Coverages window and press **Refresh Display**. The contours will be drawn in gray to the editing window.

The Edit RAS Coverages window and editing window will be used in concert to create four coverages; Main Channel Invert, Main Channel Banks, Overbank Flow Paths, and Cross Section Cut Lines. The Main Channel Banks and Overbank Flow Paths coverages are optional but will be created in this example for completeness.

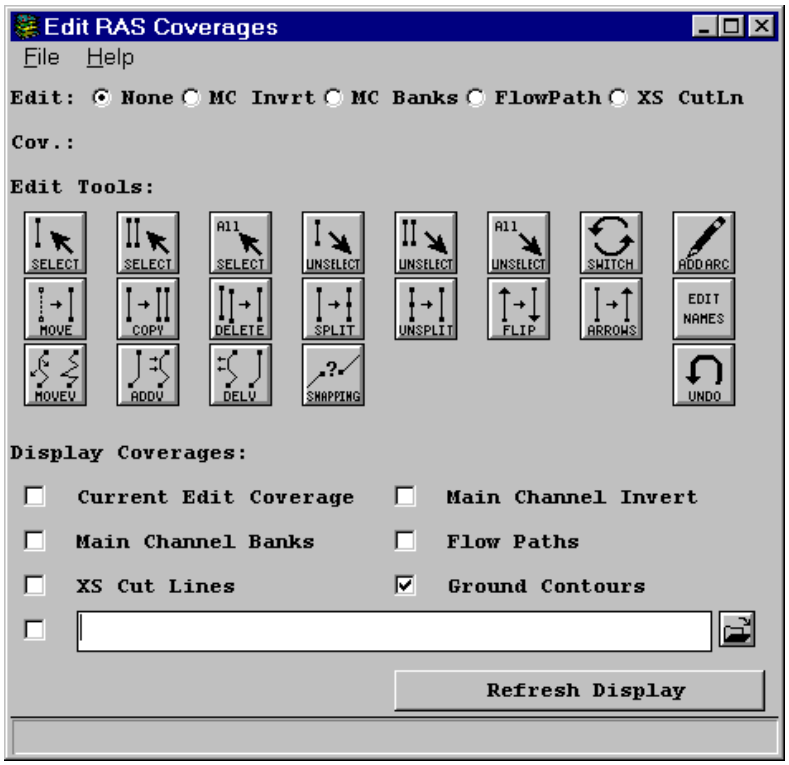

Figure 7.3 Edit RAS Coverages window

Main Channel Invert Coverage

As dictated by the Contour Coverage delineation, we are going to create the two rivers, three reach system shown in Figure 7.4. Select the **MC Invrt** choice on the top of the Edit RAS Coverages window. Draw the main channel invert by performing the following steps:

1. From the **Pan/Zoom** menu select **Extent.** Use the left mouse button to select opposite corners in the uppermost portion of the river system to zoom into.

2. Press the **ADD ARC** button on the *Edit Tools* pallete.

3. Move the mouse pointer to the upstream most point of the first river and press the right mouse button to place the FROM node. Begin moving downstream using the left mouse button to add vertices along the reach. As you run out of editing window space, select **Pan** from the **Pan/Zoom** menu and left click in the direction

you wish to pan (wherever the mouse is when you click will become the new center of the editing window). When you get to the end of a reach, right click to place the TO node.

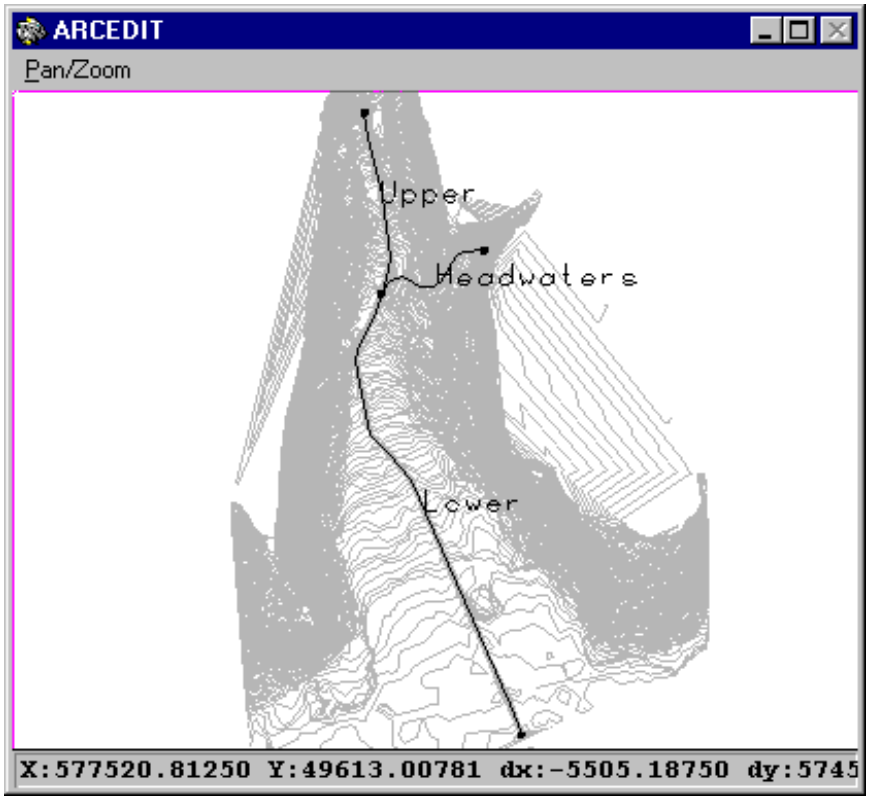

Figure 7.4 River and reach network

4. Once a reach is drawn, a window will prompt you to enter an identifier for the *River Name* and *Reach Name*. Each name is limited to 16 characters, and all reach names for the same river must be unique. In this example, the Wailupe River has two reaches named ***Upper*** and ***Lower*** and the tributary Kului Gorge has one reach named ***Headwaters***.

5. Repeat steps 2-4 for each reach. Be sure that the FROM node of the "lower" reach is coincident with the TO node of the "upper" reaches. Zoom into each junction to check.

Several options are available from the *Edit Tools* palette to more completely delineate the river network. After coarsely delineating the stream network, use the add, move, and delete vertex options to fine tune each reach. Lastly, use the **EDIT NAMES** button to double check that

each *Reach Name* is unique. Go to the **File** menu of the Edit RAS Coverages window and select **Save.**

Main Channel Banks Coverage

The next step is to establish the location of the main channel bank stations. Select the **MC Banks** choice from the top of the Edit RAS Coverages window. This will clear the Main Channel Invert Coverage from the editing window. Select the *Main Channel Invert* checkbox from the *Display Coverages* portion of the edit window and press **Refresh Display**. This will redraw the main channel to the editing window in blue.

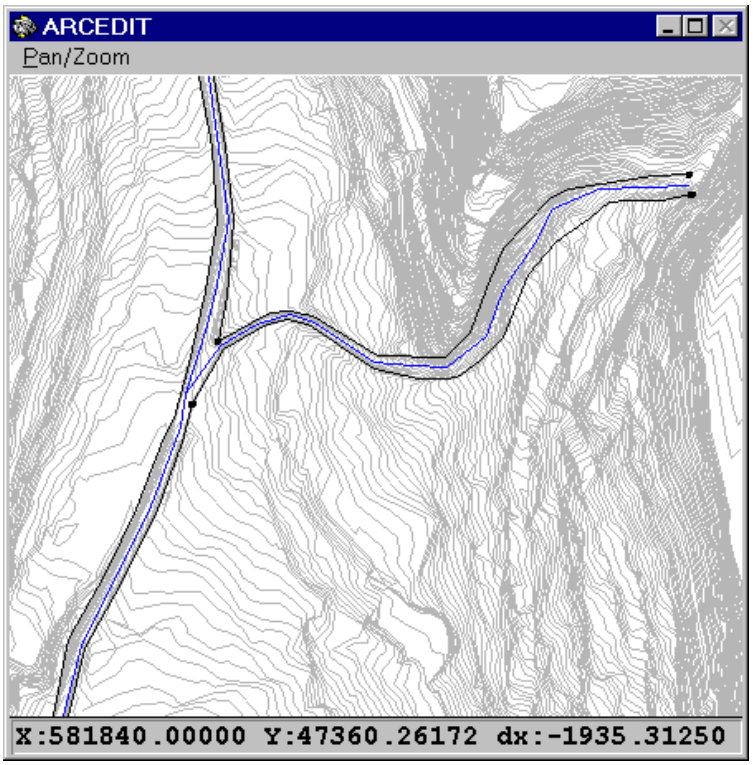

Figure 7.5 Main Channel Banks Coverage

Establish the bank station locations by using the **ADD ARC** option. Use a right click to drop the beginning node and use the left mouse button to add vertices as you draw the location of the bank stations along one side of one river. At the end of the river, right click the mouse to place the end

node. Establish bank station location lines for each side of each river using the ADD ARC option, as shown in Figure 7.5. After the bank station locations have been defined, go to the **File** menu and select **Save**.

It is okay for bank station lines of a tributary to overlap with those of the main river.

Overbank Flow Paths Coverage

Now construct the Overbank Flow Paths Coverage, as shown in Figure 7.6. Select the **FlowPath** choice from the Edit RAS Coverages window. The flow path for the main channel will be copied from the Main Channel Invert Coverage, leaving only the flow paths in the overbanks to be constructed.

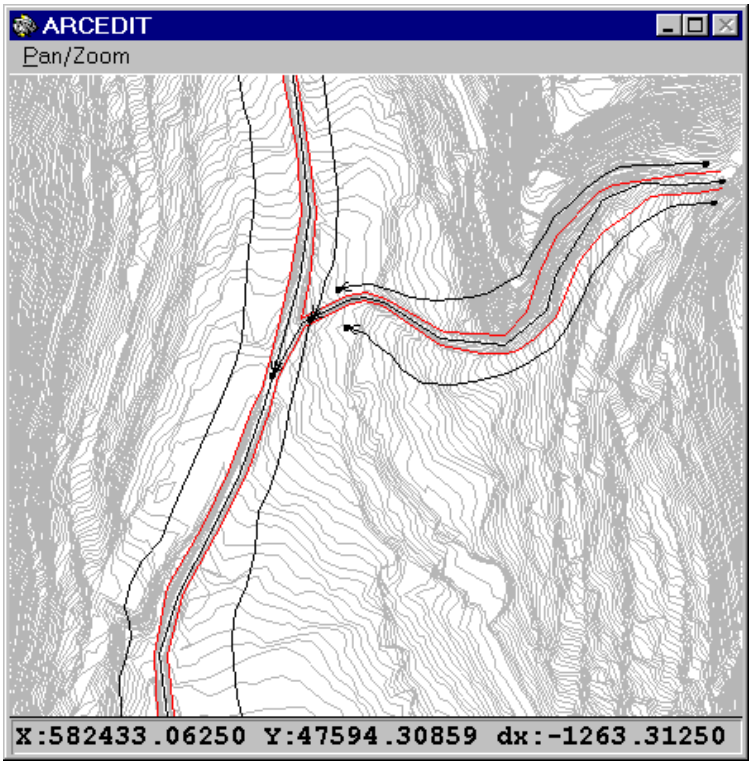

Figure 7.6 Overbank Flow Paths Coverage

Press the **ADD ARC** button and add the flow paths for the left and right overbank. Use the right mouse button to begin the flow path at the upstream end and continue downstream using the left mouse button to add

vertices. Use the right mouse button again to end the flow path. To quit drawing paths, press Ctrl + right mouse button. Use the **ARROWS** option to check that the flow paths point downstream. After you have finished all edits to the coverage, go to the **File** menu and select **Save**.

The overbank flow paths should be drawn to indicate the center of mass for overbank flow during larger flow events. The flow path coverage will be used for determining downstream reach lengths between cross sections. It is okay for flow paths from tributaries to intersect with those of the main stem.

Cross Section Cut Lines Coverage

The last coverage you need to create is the Cross Section Cut Line Coverage. Select the **Cut Line** choice from the Edit RAS Coverages window. Select the checkboxes for the *Main Channel Invert, Main Channel Bank Stations, Overbank Flow Paths,* and *Ground Contours* and press **Refresh Display**.

Cross section cut lines are created from the left overbank to the right overbank when looking downstream. Press the **ADD ARC** button to begin drawing the cut lines. Position the mouse pointer on the left edge of the left overbank and press the right mouse button to place the FROM node. Draw the cross section cut line across the floodplain using the left mouse button to dog-leg the cut line perpendicular to the flow path lines. Use the right mouse button to place the TO node at the end of the cut line. Continue adding cross section cut lines using the **Pan/Zoom** menu options to change views. Press Ctrl + right mouse button to finish adding cut lines. The Cross Section Cut Line coverage is shown in Figure 7.7 along with the main channel flow paths and bank stationing.

To copy a cross section, go to the Edit Tools palette and press the **SELECT ONE** option (SELECT MANY may be used, as well, if you want to copy many cross sections). Using the cross-hairs that appear, to select the cross section cut line to copy. Press the **COPY** button and select the location to copy the cut line using the cross-hairs. Press the left mouse button, and the cut line will be copied. The copied cross section cut line will be drawn in magenta to the screen.

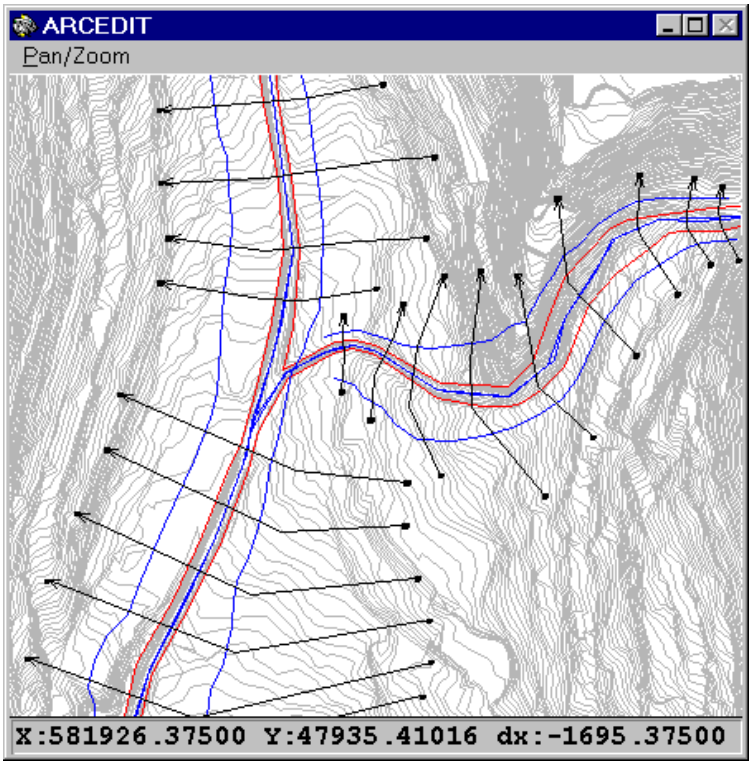

Figure 7.7 Cross Section Cut Line Coverage

Move the cut line to the desired location using the **MOVE** option. Press the **MOVE** button, and use the pointer that appears to move the cut line to the exact location. Use the vertex options to reshape the cross section cut line.

Lastly, use the **ARROWS** option to double check the cross section cut lines were created from the left overbank to the right overbank. If any cut line is oriented backwards, select the cut line using the **SELECT ONE** option and press the **FLIP** button on the *Edit Tools* palette. When finished editing and checking the cut lines, go to the **File** menu and select **Save**.

When finished creating the four RAS Coverages, select **Exit** from the **File** menu to quit from the Edit Coverage window.

Creating a HEC-RAS Import File

Now that the RAS Coverages have been created, you are ready to create the RAS Import File. Press the **Create RAS Import File** button on the project manager. The window shown in Figure 7.8 will appear. Enter the name of the import file to create and press the **Create Import File** button. The status window shown in Figure 7.9 will appear and be updated as the attribute data for the RAS Coverages is checked.

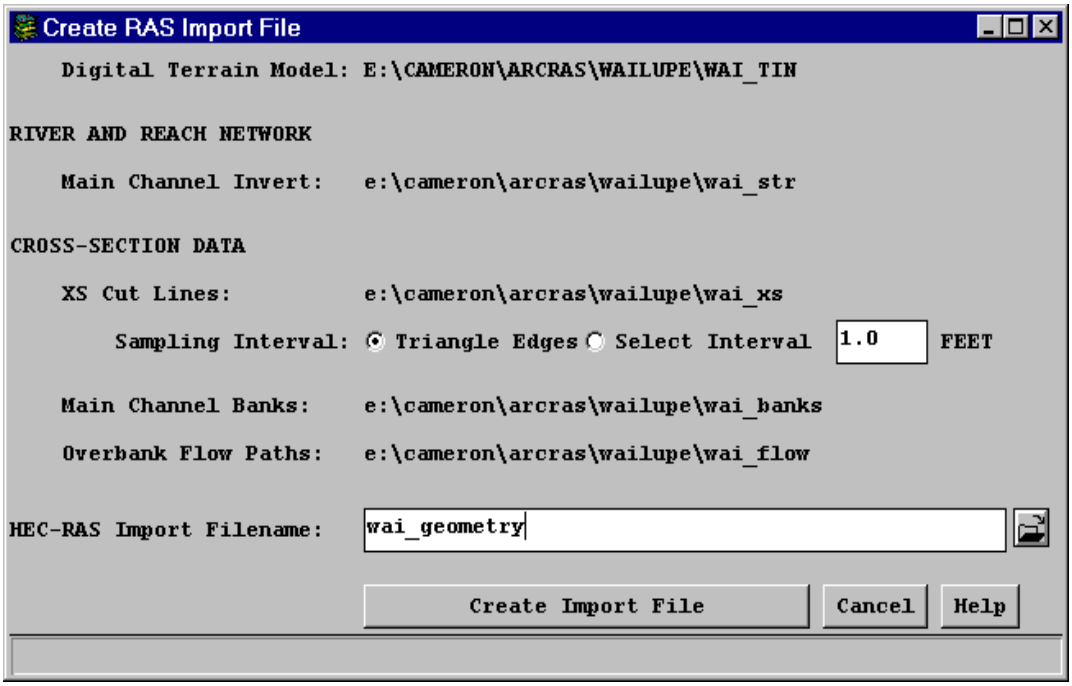

Figure 7.8 Create RAS Import File window

Because the route system for the river network does not exist, you will be prompted to establish river stationing. The editing display window will appear with the Main Channel Invert Coverage displayed. One of the rivers will be displayed in green and a message window will prompt you to select the downstream most point in the reach. Select the downstream most point with the cross-hairs and press the left mouse button. Next, a window will allow you to enter the river station for that location. Zero is the default. Enter the river stationing and press **OK**. This procedure is repeated for each river.

After the RAS Import File has been created, a message window will appear informing you the file has been successfully created. Press **OK** to dismiss the window.

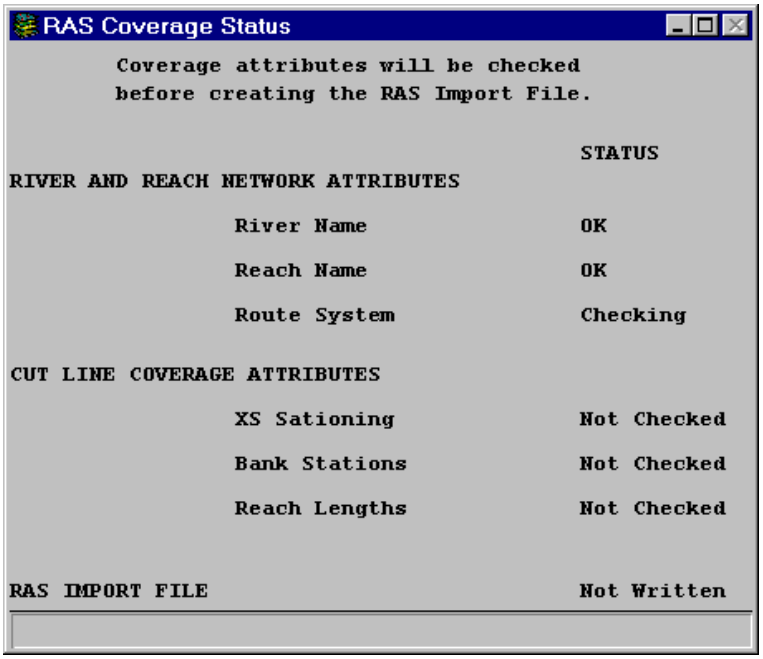

Figure 7.9 RAS Coverage Status window

Running RAS

To use HEC-RAS in concert with the GIS, perform the following steps:

1. Import the the RAS Import File into HEC-RAS from the Geometric Data Editor.

2. Complete the following hydraulic data: roughness coefficients, expansion and contraction coefficients, and hydraulic structure data. For a more complete discussion on importing geometric data refer to the HEC-RAS User's Manual, Chapter 13.

3. Run simulations in HEC-RAS and review the output.

4. Export the water surface profile results back to the GIS. For a more complete discussion on exporting GIS data refer to the HEC-RAS User's Manual, Chapter 13.

Importing a HEC-RAS Export File

To begin the import procedure press the **Import RAS Export File** button from the project manager. The window shown in Figure 7.10 will appear allowing you to browse for the GIS file. Select the file to import and enter the name of a new coverage to be created. The new coverage will contain cross-section attribute data along with water surface elevations at each cross section for each profile. Press **OK** to continue.

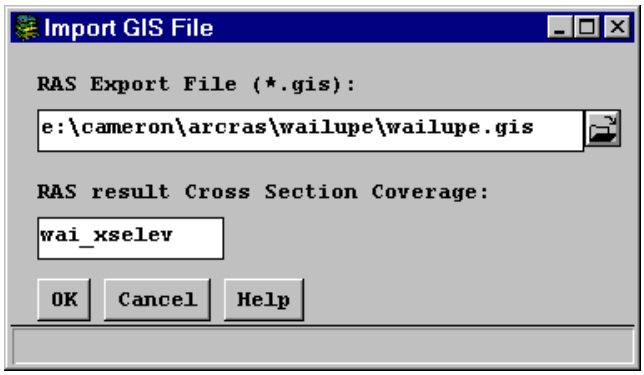

Figure 7.10 Import GIS File window

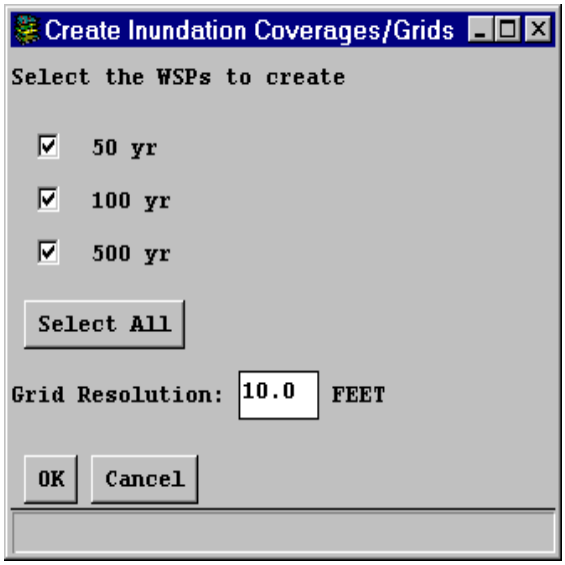

Figure 7.11 Water surface profile selection window

Pressing **OK** from the Import GIS File window will invoke a the Create Inundation Coverages/Grids shown in Figure 7.11. Select the checkboxes corresponding to the water surface profiles you wish to view and enter the resolution for the depth grid(s). Press **OK** to begin creating the water surface coverages from the exported water surface profile data.

You will be notified upon successfully creating the water surface profile coverages. Press **OK** from the message window continue.

Inundation Mapping

The next step is to view the extent and depth of floodplain inundation. Press the Inundation Mapping button on the project manager. The window shown in Figure 7.12 will appear along with a display window.

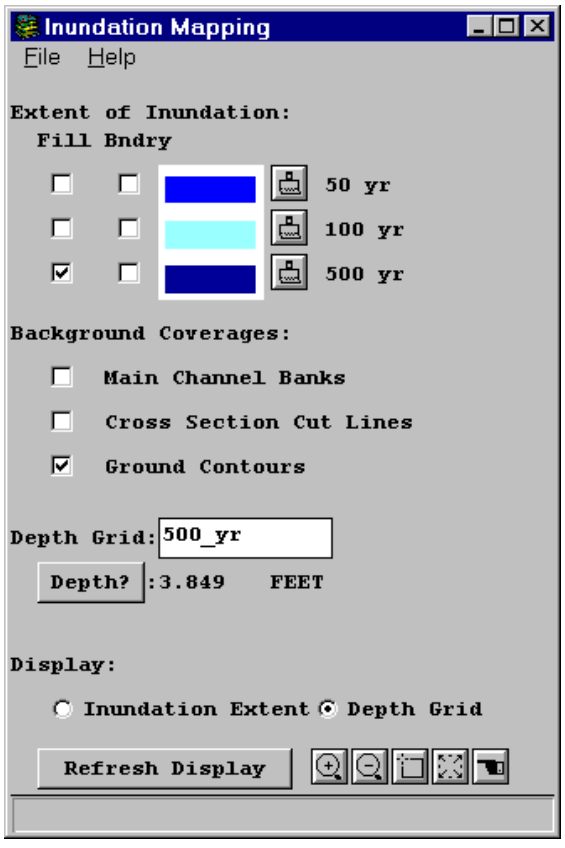

Figure 7.12 Inundation Mapping window

Select the checkbox that corresponds to the event, ground contours, and other background coverage(s) you wish to view and press the **Refresh Display** button. Shown in Figure 7.13 is a water surface flood extent polygon displayed over the *Ground Contours*.

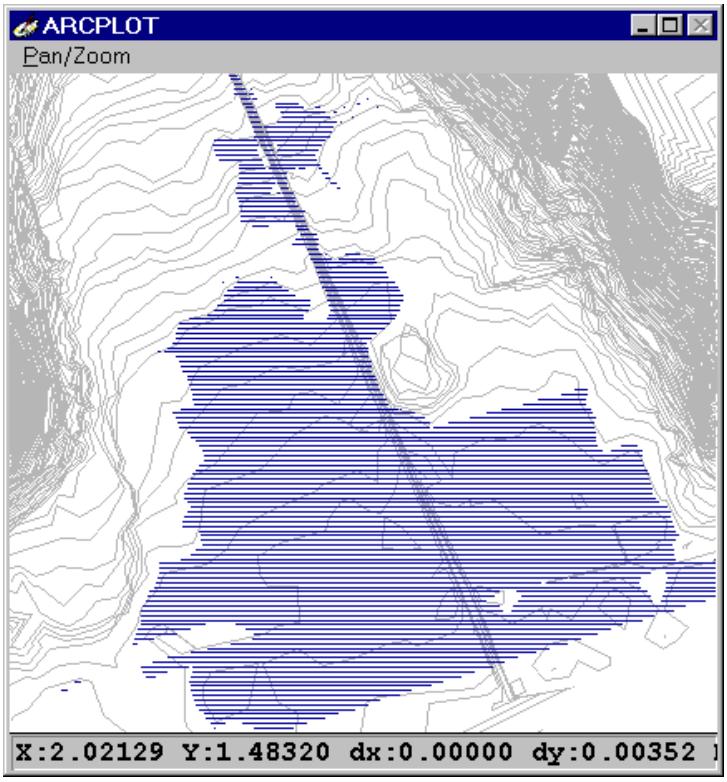

Figure 7-13 Water surface extent polygon coverage

Next, select the depth grid that corresponds to the water surface you just viewed. Right click over the *Depth Grid* input field and a list of available grids will appear from which to choose. (You can also type the name of the grid in the field.) Select the depth grid and press **OK**. To view the depth grid, choose *Depth Grid* from the *Display* option and press the **Refresh Display** button. As shown in Figure 7.14, a blue-scaled grid will be displayed, this time with the contours on top. Darker blue indicates greater inundation depths.

Press the **Depth?** button to find out the depth of inundation at key locations. Cross-hairs will appear that allow you to left click at points over the grid. The depth at those points will be shown to the right of the **Depth?** button. Right click when finished determining depths.

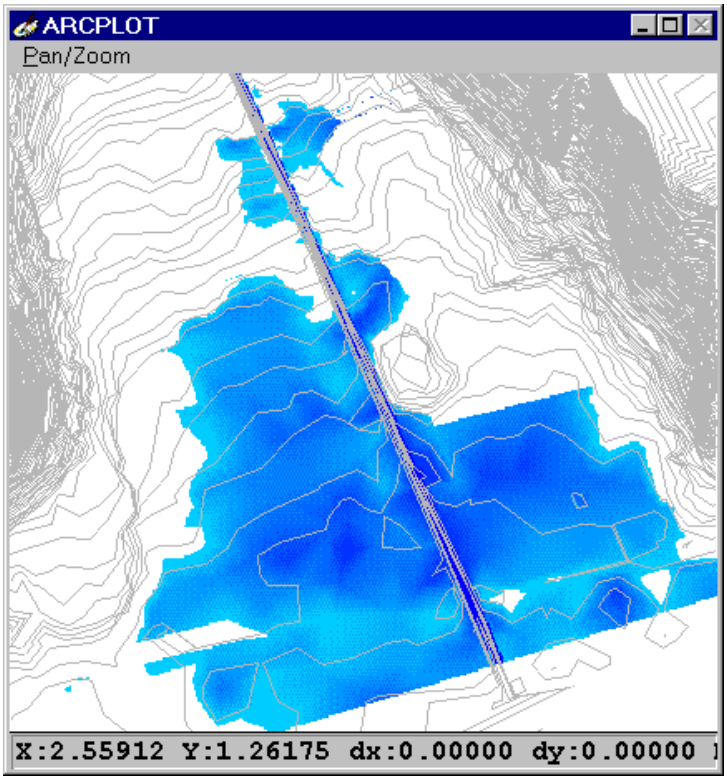

Figure 7.14 Shaded depth grid of floodplain inundation

Printing Map Results

Prepare the view you wish to print using the display options on the Inundation Mapping window. From the **File** menu select **Print**. The Print Map window shown in Figure 7.15 will be invoked, although the text fields will be blank.

Select the *Border* checkbox and press the **Preview** button. The page, as it will be printed will be drawn to the display window. If the you wish to change the inundation map, select **Exit** from the **File** menu. You will be returned to the inundation mapping window to change the view.

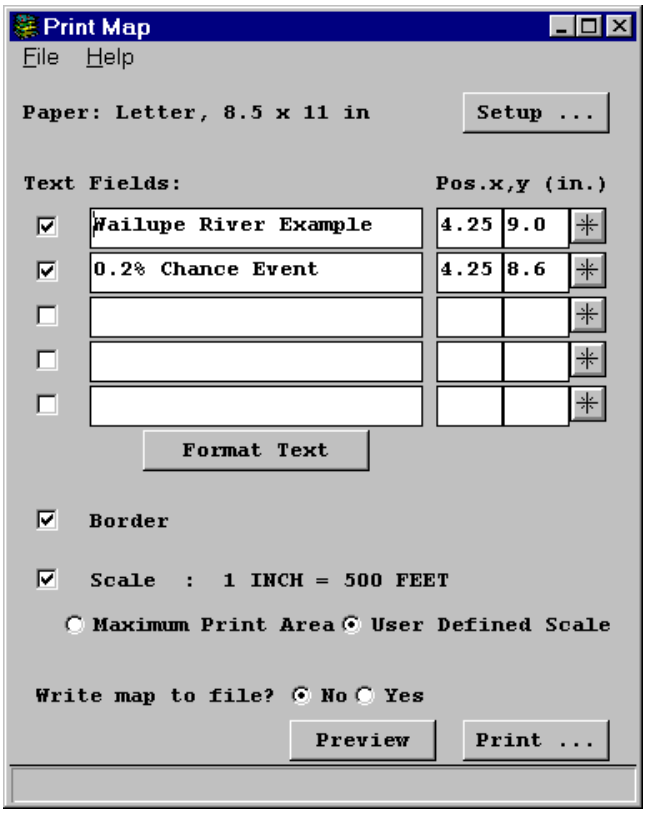

Figure 7.15 Print Map window

Select the desired page size, and margins using the **Setup** button to activate the Page Setup window. To change the page size, right click over the *Page Size* field to invoke a select list. After leaving the Page Setup window, press the **Preview** button to see the changes made to the page setup.

Add a title to the map by typing in one of the text fields. Use the cross-hairs to position the text on the map, or enter the page coordinates manually. Press the **Preview** button to see how the text looks. To format the text use the **Format Text** button located beneath the text input fields.

Before printing, select the scale of the map. To print the map scale on the map, select the map scale checkbox. Use the **Preview** option to see how your map will look at the new scale. An example map is shown in Figure 7.16.

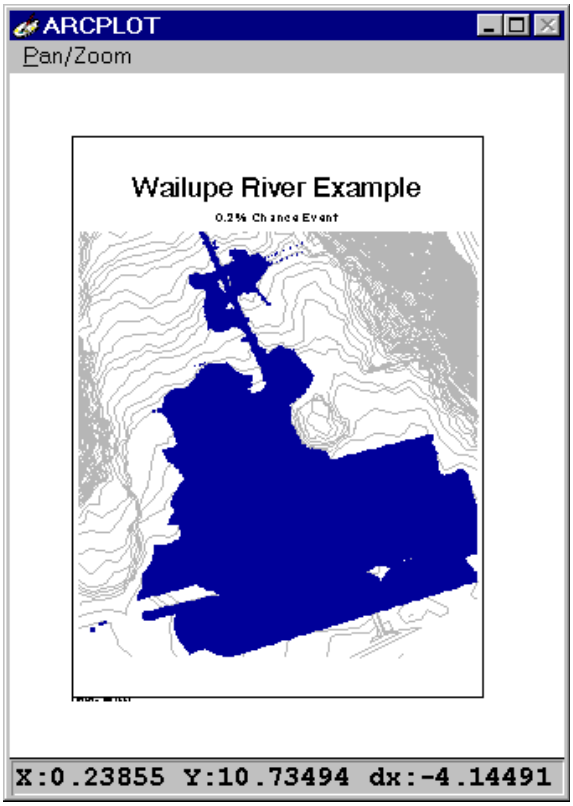

Figure 7.16 Preview of inundation map

When satisfied with your inundation map press the **Print** button. If you elected to write the map to a file, your map will be written to the filename specified. Otherwise, a temporary file will be created. The ARC/INFO print interface will then be invoked.

The print interface for Windows NT differs from the UNIX interface. For Windows NT the following steps are required: (1) select the print *Driver* and press **Print** (if you did not elect to write the map to a file, the file *tempprintfile.gra* will be selected as the file to print); (2) choose the destination printer from the Windows NT print manager and press **Print**. For UNIX the following steps are required: (1) select the file to be printed (if you did not elect to write the map to a file, the file *tempprintfile.gra* will be selected as the file to print) and double click on the destination printer; (2) edit the page attributes if desired and press **Print**.

When finished printing, choose **Quit** from the ARC/INFO print interface and select **Exit** from the **File** menu on the Print Map window. You will be returned to the Inundation Mapping window.

Exiting HEC-GeoRAS

When finished viewing water surfaces return to the project manager by selecting **Exit** form the **File** menu. From the **File** menu on the HEC-GeoRAS Project Manager select **Exit**. Upon exiting, the user will always be asked to save the current project. The user will be returned to the Arc prompt.